CHAPTER 9

DISCIPLINE TASK PROFILES

The National Council of Examiners for Engineering and Surveying (NCEES) oversees the design and administration of licensing exams in various engineering disciplines. Exams are updated periodically and are based on the surveys of practicing engineers regarding the frequency and/or importance of their job tasks. NCEES employs private consulting firms to design, administer and analyze these job analysis surveys. Reports typically summarize demographic and professional characteristics of the respondents and summary measures on the frequency and importance of each task. ISR obtained the job analysis data files for 6 disciplines (agricultural, electrical, mechanical, metallurgical, petroleum and structural) and printed reports for 9 disciplines (chemical, civil, control systems, geotechnical, industrial, manufacturing, nuclear, special civil and traffic) where the raw data was not available. In some cases the consulting firms considered the data proprietary and refused to make it available for analysis. NCEES does not maintain this raw data.

In ISR's judgment, a more detailed analysis of the job analysis data could be used to strengthen the exams and maintenance of succeeding analyses of a single discipline could be used to track changes in the field. The latter would be useful to engineering educators and to the professional organizations as well as those involved in exam preparation.

While these job analyses are designed for use in creating licensing exams, in this report the data provide a profile of the types of knowledges and activities that define each engineering discipline. The tables in this chapter highlight those items that are ranked as important or critical for each engineering discipline.

Job Analysis Data and Reports

Several different firms with differing approaches perform the analyses of the discipline specific tasks and knowledges that are used in the creation of licensing exams. Each of the practice and title act disciplines have been analyzed, except for nuclear engineering for which a comparable job analysis has not been performed due to the small number of examinees, and fire protection engineering for which the report was not complete at the time of this study. The results of these analyses are presented in the following tables. The job analyses that were made available for this analysis in the summer of 2001 varied in the following ways: 1) number and specificity of items, 2) items representing tasks, skills, and/or knowledges, 3) ratings of importance or of criticality, 4) and range of scales. Access to the data from these analyses also varied and when raw data was not provided, reliance on the way data is officially reported was necessary. Some reports did not include results for the whole sample, but instead reported results for subgroups. Most reports included mean scores, but some did not include standard deviations or other data that would allow standard deviations to be calculated.

The tables attempt to present the data in the most comparable form as is possible. Items with average ratings that exceed a critical threshold are included in the tables. The critical threshold is set by the job analysis report in most cases and it varies due to the differences in the scales used. For scales of 0 to 4, the cutoff is a score of 2.5, while with scales of 0 to 5 the cutoff is a score of 3.5. These are the midpoints between ratings of moderately important and very important in most cases (the language varies slightly among the job analyses). For two of the job analyses, special civil and traffic, the cutoff point is lowered to 3 on a 0 to 5 scale because there are so few items that reached the standard cutoff level.

Practice Act Disciplines

Civil engineering. The job analysis of civil engineering is a general survey with 50 items and low levels of specificity in which respondents were asked to rate each item's importance on a scale of 0 to 4. The job analysis instrument was created and administered by the National Council of Examiners for Engineering and Surveying (NCEES) in 1989. Table 9.1 identifies the tasks rated as important in this analysis. No variability data are available for this discipline. The items that are considered important are mostly general in nature, such as ability to communicate and knowledge of ethics. Several items in the structural area are also rated as important to the practice of civil engineering. Due to the structure of this survey, which asked the engineers to rank a relatively small number of items that are general in nature, the profile of civil engineering that emerges is limited. Table 9.2 lists the important items on the Special Civil engineering discipline analysis that informs the Special Civil engineering exam required of all civil engineers who are seeking licensure in California. This survey was developed and administered by CTB/McGraw Hill in 1997, and it asks respondents to rate the importance of 22 task and 109 knowledge items on a scale of 1 to 5, and items that are not at all important are not rated. The cut off point for inclusion in Table 9.2 was lowered to 3 because there were very few tasks and knowledges with average ratings of 3.5 or higher. This job analysis provides considerable detail that is specific to the practice of civil engineering. It is divided into the tasks and knowledges that are necessary for two components of civil engineering: engineering surveying and seismic principles.

There appears to be some relationship between the degree of importance and the amount of variability in the ratings of importance for a particular item. Those items that have the highest average importance ratings are more likely to be the items with the least variability. This indicates a high level of agreement among civil engineers that these tasks are very important to their occupation. Multiple items in the areas of engineering surveying field measurements, engineering surveying calculations, and engineering surveying office procedures have high importance ratings and low levels of variability. The items with the most variability are all seismic principles knowledge items, which are rated as important but not most important for the civil engineering profession.

Civil engineers must take additional exams if they wish to use the title of geotechnical or structural engineer, and detailed job surveys are administered to engineers in these disciplines. Table 9.3 illustrates the critical job tasks measured by the job analysis for geotechnical engineering. This job analysis was developed and administered by the Office of Examination Resources at the California Department of Consumer Affairs in 1994 and it asks respondents to rate how critical 68 task and 77 knowledge items are on a scale of 0 to 5. While many items are rated as critical, the most critical task and knowledge items are mostly in the areas of reconnaissance and project planning and analyses and development of conclusions and recommendations. Standard deviation measures are not available for this analysis, so the variability of the responses is not known.

The results for structural engineers are provided in Table 9.4. The Office of Examination Resources at the California Department of Consumer Affairs produced this analysis in 1997 and respondents were asked to rate the importance of 51 task and 108 knowledge items on a scale of 0 to 5. These results indicate that the most important job tasks and knowledges are in the areas of selection of structural systems, design of structural elements, and structural analysis procedures. The items with the highest importance ratings are, again, the items with the least variability.

Electrical engineering. The inquiry into the important knowledges associated with electrical engineering was produced by NCEES in conjunction with the Chauncey Group International in 2000. Respondents rate the importance of 58 breadth knowledge items on a scale of 0 to 4. Table 9.5 shows that the highest ranked items in this analysis are found in many categories, but the majority are in the area of electric circuits. The standard deviation scores indicate that the highest ranked items have the least variable responses while the lower rated items are more likely to have higher standard deviations, indicating lower levels of agreement about the importance of these items.

Mechanical engineering. A detailed study of mechanical engineering tasks and knowledges, developed and administered by NCEES in cooperation with the Chauncey Group International in 1999, provides an insight into the important requirements for this engineering discipline. Respondents were asked to rate the importance of 64 task and 75 knowledge items on a scale of 0 to 4. Table 9.6 shows that the area with the highest ranked items is general knowledge, such as relevant engineering terminology, fluid mechanics, heat transfer principles, and ethics. The most important items have the lowest standard deviation scores, as found in the other analyses, indicating a high level of agreement among mechanical engineers that these tasks and knowledges are important to their occupation.

Title Act Disciplines

Agricultural engineering. The job analysis for agricultural engineering, produced and administered by NCEES in conjunction with the Chauncey Group International in 2000, asks respondents to rate the importance of 68 task and 97 knowledge items on a scale of 0 to 4. Table 9.7 indicates that the most important items are in the areas of soil and water, structures and environment, and core tasks and knowledges. This analysis shows that agricultural engineers agree that a wide range of tasks and knowledges are important to their occupation.

Chemical engineering. The job analysis for chemical engineering is similar in design to the basic civil engineering analysis, and was also produced by the National Council of Examiners for Engineering and Surveying (NCEES) in 1989. The survey had 39 general items for the participating engineers to evaluate for importance on a scale of 0 to 4. Those items in Table 9.8 that ranked as most important were communication, chemistry, and mass and energy balances. No measures of variability were provided for these average importance scores, so level of agreement among respondents is unknown.

Control systems engineering. The University Research Corporation analyzed the activities and requirements of the control systems engineering profession for the Instrument Society of America and NCEES in 1991. Respondents for this study were asked to rate the importance of 240 items on a scale of 0 to 5. Table 9.9 shows that many activities and professional requirements are considered to be important by control systems engineers. The most important items are in the area of conceptual design and definition of controls systems, control strategies, and documentation. Standard deviations for the mean importance scores were not provided, so no conclusions regarding the variability of responses can be made.

Industrial engineering. The NCEES administered a job analysis for industrial engineers in 1989. As in the other analyses performed by NCEES, this study asked respondents to rate the importance of 43 general knowledges, skills, and abilities on a scale of 0 to 4. Table 9.10 indicates that most of the items rated as important are general, such as ethics, engineering economics, and communication, software, and statistics. The items that are more specific to industrial engineering and that rank most important are management principles and cost

analysis. No standard deviation scores were provided for the mean importance ratings, so nothing can be concluded regarding the variability of the responses.

Manufacturing engineering. The Chauncey Group International with NCEES analyzed the knowledge areas associated with the manufacturing engineering profession in 1999. This job analysis was unique because it did not include items that the vast majority of manufacturing engineers agree are common or fundamental to their discipline. The instrument contained only items that were of questionable importance. The results in Table 9.11, therefore, may provide a partial profile of manufacturing engineering. Respondents were asked to rank the importance of 70 knowledge items on a scale of 0 to 4. Table 9.11 indicates that the items ranked as important for manufacturing engineering are in the areas of product/process design and materials application, manufacturing process applications and operation, production system and equipment design, and quality. The two items ranking most important also had the lowest standard deviation scores, indicating a high level of agreement that these are indeed important knowledges for the manufacturing engineering profession.

Metallurgical engineering. The Chauncey Group International with NCEES also performed the study of metallurgical engineering in 2000. Respondents were asked to rate the importance of 133 knowledges using a scale of 0 to 4. The important knowledge areas indicated in Table 9.12 include general knowledge, extractive metallurgy, physical metallurgy, mechanical metallurgy, and materials. Only a few items are rated as most important and they are in the general knowledge and material testing areas. There is not a strong relationship between the variability of the responses and the importance ratings in this analysis, which may indicate that the importance of particular tasks varies by job setting or some other factor.

Petroleum engineering. Petroleum engineering was studied by the Chauncey Group International with NCEES in 1999. Table 9.13 indicates that petroleum engineers rate many of the 25 task and 65 knowledge items as important on a scale of 0 to 4. The areas with the most items of importance are common knowledges, drilling, completion, production and facilities, reservoir, and formation evaluation. The highest rated items are more likely to have the lowest standard deviation scores, indicating higher levels of agreement in respondents' ratings.

Traffic engineering. The traffic engineering job analysis was developed and administered by the Office of Examination Resources at the California Department of Consumer Affairs in 1999 and it asks respondents to rate how important 66 task and 102 knowledge items are on a scale of 0 to 5. The cut off point for inclusion in Table 9.14 was lowered to 3 because there were very few tasks and knowledges with average ratings of 3.5 or higher. Table 9.14 shows that several task and knowledge items are rated as important by respondents. The most important items are mostly in the knowledge areas of circulation, trip generation, parking and land use and traffic controls. The report did not provide any standard deviation data.

Summary

The job analyses vary considerably by discipline, but each study provides a source for understanding the important tasks, skills, and knowledges that are important for that profession. The variability of ratings is generally greater for those items that have a lower average rating, indicating a general lack of agreement about less important items among practitioners of the occupation, while the highest rated items often had the least variability indicating high levels of agreement about more important ones. Each table provides a profile of a licensed engineering discipline in California.

Comparability between disciplines is limited by variations in the goals, methodologies, and analytical techniques used by the separate disciplines in the design of their job analysis survey. Some disciplines provide a very brief and general description of important tasks and knowledges in their discipline, while others seek to provide a more extensive and detailed description of their field. Most focus on the most common tasks performed by practitioners in their discipline; one discipline (manufacturing) omits the more common tasks and focuses on less widely shared tasks in newly developing or unusual applications of the discipline. The surveys themselves vary in the number and specificity of items, in the scale used and in the type of rating requested (for example, importance or criticality). They also differ in the measurement of educational background and job experience and in whether unlicensed engineers are included in the sample. Published reports on the results vary in the descriptive statistics used and in how the sample is grouped for analysis. Some describe the sample as a whole while others describe only subgroups within the sample. No effort is made to profile the variations in tasks in different job settings or by engineers with different levels of experience. Thus, these differences in approach undermine the usefulness of the job analyses for the measurement of overlap between engineering disciplines.

Table 9.1. Items Rated Important on the Civil Engineering Occupation Analysis

			Importance Score (0-4)	Score, Most Important (3 or Higher)	S. D. Most Variable NA*	S.D. Least Variable NA*
A. Ethics	1)	Canon of Ethics of Professional or Technical Society	2.6			
	2)	Rules of Professional Conduct of State Registration Board	2.7			
B. Engineering Economics	1)	Engineering Economics	2.5			
C. Communication	1)	Oral Communications	3.4	3.4		
	2)	Written Communications	3.4	3.4		
	3)	Drawing and Graphics	3.1	3.1		
D. Physical and Engineering Sciences	1)	Statics	2.8			
E. Computer Science	1)	Software	2.5			
F. Codes and Standards	1)	Codes and Standards	3.1	3.1		
G. Structural	1)	Loadings	2.9			
	2)	Structural Analysis	3.0	3.0		
	3)	Member Design	2.9			
	4)	Construction Techniques/Equipment/Materials	2.8			

*Standard deviation data not provided.

Table 9. 2. Items Rated Important on the Special Civil Engineering Occupation Analysis

Engineering Surveying Tasks		Importance Score (1-5)*	Score, Most Important (3.5 or higher)	S.D., Most Variable NA**	S.D., Least Variable NA**
A. Engineering Surveying Equipment and Field Calculations	1) Recognize the Purposes of Different Types of Surveys	3.22			
	2) Practice within the Laws Regulating Engineering Surveying	3.18			
	3) Recognize Common Construction Surveying Methods and Procedures	3.28			
B. Engineering Surveying Field Measurements	1) Perform the Measurement of Horizontal Distances	3.13			
	2) Perform the Measurement of Elevations from Leveling	3.16			
C. Engineering Surveying Calculations	1) Perform Basic Geometric and Trigonometric Calculations	3.84	3.84		
	2) Determine the Properties of a Horizontal Curve	3.26			
	3) Determine the Properties of a Vertical Curve	3.22			
	4) Perform Leveling Calculations from Field Data to Determine Elevations	3.18			
	5) Perform Rectangular Coordinate System Calculations	3.17			
	6) Perform Calculations to Determine Quantities of Construction Materials	3.57	3.57		
D. Engineering Surveying Office Procedures	1) Recognize Information from Legal Boundary and Easement Data Pertinent to Engineering Surveying Projects	3.28			
	2) Recognize the Use of Datums for Horizontal and Vertical Control	3.38			
	3) Prepare Topographic And Planimetric Maps	3.16			
	4) Interpret Existing Maps	3.78	3.78		

Engineering Surveying Knowledges		Importance Score (1-5)*	Score, Most Important (3.5 or higher)	S.D., Most Variable	S.D., Least Variable
A. Engineering Surveying Equipment and Field Activities	1) General Methods and Procedures of Control Surveys	3.09			1.11
	2) General Methods and Procedures of Construction Surveys	3.25			1.08
	3) General Methods and Procedures of Topographic Surveys	3.24			1.09
	4) Accuracy of Measurements Made with Survey Equipment	3.09			
	5) Scope of Practice of Engineering Surveying as Defined by the Professional Engineers Act and the Scope of Practice of Land Surveying as defined by the Professional Land Surveyors Act	3.20			
	6) Construction Layout Requirements to Enable the Contractor to Construct the Project	3.43			
	7) Horizontal Curve Layout	3.21			
	8) Horizontal and Vertical Curve Layout	3.30			
	9) Line and Grade Layout	3.38			
	10) Potential Conflicts with Underground Utilities	3.80	3.80		
	11) Location, Orientation, and Terminology for Construction Staking	3.26			
	12) Offset Distance Computations	3.13			
	13) Roadway Layout	3.18			
B. Engineering Surveying Field Measurements	1) Definitions of Leveling Terminology	3.36			
	2) Procedure for Sighting the Telescope and Reading the Rod	3.01			

*Importance scores of 3 or higher used as cutoff; not comparable to other tables.

** Standard deviation data not provided for task items.

Table 9. 2. (continued) Items Rated Important on the Special Civil Engineering Occupation Analysis

Engineering Surveying Knowledges		Importance Score (1-5)*	Score, Most Important (3.5 or higher)	S.D., Most Variable	S.D., Least Variable
C. Engineering Surveying Calculations	1) Properties of a Right Triangle	3.82	3.82		1.08
	2) General Trigonometric Formulas	3.80	3.80		1.08
	3) Properties of an Oblique Triangle	3.47			
	4) Trigonometric Relationships to Determine the Area of a Polygon	3.30			
	5) Geometric Properties and Equations of a Circular Curve	3.27			
	6) Circular Curve Deflections	3.01			
	7) Procedure for Locating a Point on a Curve	3.10			
	8) Procedure for Calculating Stations for the Point of Intersection, Beginning of Curve, and End of Curve	3.29			
	9) Procedure for Calculating the Intersection of a Curve and a Straight Line	3.08			
	10) Geometric Properties and Equations of a Parabola	3.00			
	11) Procedure for Calculating a Vertical Curve	3.20			
	12) Procedure for Calculating Vertical Curves from Tangent Offsets of Grade Lines	3.03			
	13) Procedure for Calculating Intermediate Points	3.03			
	14) Procedure for Calculating the Highest or Lowest Point	3.15			
	15) Procedure for Calculating the Rate of Gradient	3.08			
	16) Procedure for Calculating Profile Grade and Elevations on the Tangents	3.17			
	17) Procedures for Calculating Distances from Coordinates	3.27			
	18) Procedures for Calculating Bearings or Azimuths from Coordinates	3.17			
	19) Coordinate Geometry Relationships	3.18			
	20) Procedures for Calculating an Area from Rectangular Coordinates	3.13			
	21) Methods for Calculating Volumes of Materials	3.64	3.64		1.09
	22) Procedures for Calculating Volume by Average-End-Area Method Including Using Cross-Sections	3.47			
	23) Procedures for Calculating Volume by Prismoidal Method	3.04			
D. Engineering Surveying Office Procedures	1) Procedure for Plotting Profiles	3.07			
	2) Procedure for Plotting Cross-Sections	3.10			
	3) Procedure for Plotting Field Points and Data	3.06			
	4) Applications of Stationing	3.29			
	5) Relationship Between Grade Lines and Cross-Sections	3.25			
	6) Standard Formats and Terminology of Legal Descriptions	3.06			
	7) Purpose of Control Monuments	3.18			
	8) Different Types of Horizontal Datums	3.09			
	9) Different Types of Vertical Datums	3.14			
	10) Purposes and Types of Bench Mark Systems	3.20			
	11) Contour Intervals	3.48			1.09
	12) Methods to Plot Contours from Field Information	3.20			
	13) Methods for Interpolating Contours	3.32			1.12
	14) Map Scales	3.88	3.88		1.04
	15) Common Conventions of Map Orientation	3.69	3.69		1.04

*Importance scores of 3 or higher used as cutoff; not comparable to other tables.

** Standard deviation data not provided for task items.

Table 9. 2. (continued) Items Rated Important on the Special Civil Engineering Occupation Analysis

Engineering Surveying Knowledges		Importance Score (1-5)*	Score, Most Important (3.5 or higher)	S.D., Most Variable	S.D., Least Variable
D. Engineering Surveying Office Procedures	16) Standard Map Symbols	3.55	3.55		1.04
	17) Characteristics and Purposes of Different Types of Maps	3.74	3.74		1.04
	18) Purpose of Geographic Information System (GIS)	3.04			1.08
Seismic Principles Tasks		**Importance Score (1-5)***	**Score, Most Important (3.5 or higher)**	**S.D., Most Variable** NA**	**S.D., Least Variable** NA**
A. Seismic Data and Seismic Design Criteria	1) Understand Earthquake Data that Influence Design of Projects	3.58	3.58		
	2) Understand Geotechnical Issues that May Influence Design of Projects	3.74	3.74		
	3) Recognize Design Performance Goals for a Project	3.56	3.56		
	4) Recognize Laws, Codes, and Standards Governing Seismic Design	3.64	3.64		
B. Seismic Characteristics of Engineered Systems	1) Determine Appropriate Seismic Resisting Structural System	3.36			
	2) Recognize Seismic Performance and Damage Vulnerability of Structures	3.28			
	3) Understand Methods for Seismic Strengthening of Existing Structures	3.25			
	4) Recognize the Requirements for Lifelines	3.08			
	5) Understand Requirements for Earth Structures	3.20			
C. Seismic Forces	1) Determine Structural Characteristics Required to Calculate Seismic Design Forces	3.31			
	2) Determine UCB Seismic Design Forces for Buildings	3.22			
	3) Determine Seismic Forces for Elements of Structures, Non-Structural Components, and Equipment	3.04			
D. Seismic Analysis Procedures	1) Determine the Distribution of Forces to Structural Elements Based on Their Rigidities	3.10			
E. Seismic Design	1) Understand the Detailing Requirements that are Critical for Seismic Performance	3.31			
	2) Recognize the Need for Construction Quality Monitoring and Inspection of the Seismic Design Aspects of the Project	3.42			
Seismic Principles Knowledges		**Importance Score (1-5)***	**Score, Most Important (3.5 or higher)**	**S.D., Most Variable**	**S.D., Least Variable**
A. Seismic Data and Seismic Design Criteria	1) Earthquake Accelerographs, Response Spectra, and Ground Acceleration	3.05			
	2) Geologic Seismic Hazards and Geotechnical Data That Affect Design, Including Liquefaction, Slope Stability, Settlement, and Faulting	3.73	3.73		1.12
	3) UBC Site Coefficient	3.20			
	4) Soil Structure Interaction, Including the Effective Natural Period of the Structure and the Expected Period of the Seismic Ground Motion	3.16			
	5) Lateral Seismic Earth Pressure on Retaining Structures	3.41			
	6) Seismic Design Philosophy of the UBC	3.16			
	7) Seismic Performance Levels such as Life Safety, Operational, Fully Functional	3.33			
	8) Practice Law, Responsible Charge Criteria, Practice Within Area of Competency	3.38			
	9) The UBC and the California Building Coded for New Construction	3.42			

*Importance scores of 3 or higher used as cutoff; not comparable to other tables.

** Standard deviation data not provided for task items.

Table 9. 2. (continued) Items Rated Important on the Special Civil Engineering Occupation Analysis

Seismic Principles Knowledges		Importance Score (1-5)*	Score, Most Important (3.5 or higher)	S.D., Most Variable	S.D., Least Variable
B. Seismic Characteristics of Engineered Systems	1) Different Structural Systems and Their Design Parameters	3.21			
	2) Performance Characteristics of Different Structural Systems	3.19			
	3) Effects of Ductility, Damping, Redistribution, and Redundancy on Seismic Performance	3.00			
	4) Types of Construction with Poor Seismic Performance	3.30			
	5) Effects of Overstress on Seismic Structural Components or Systems	3.01			
	6) Methods and Effects of Adding Overall Strength	3.07			
	7) Methods and Effects of Strengthening Weak-Links in Structural Systems	3.06			
	8) Earthquake Design Requirements for Power, Communications, Natural Gas, Liquid Fuels, Water, and Sewage Systems	3.03			
	9) Seismic Loading for Retaining Structures and Tunnels	3.15			
	10) Seismic Requirements for Landfills, Cuts and Fills, Engineered Grading, etc.	3.06			
C. Seismic Forces	1) Mass and Stiffness	3.12		1.41	
	2) UBC Static Force Procedures	3.14		1.46	
	3) Choice and Application of RW Factor	3.05		1.48	
	4) UBC Design Base Shear Using Z, I, C, W, S, T, and Rw Factors	3.19		1.50	
	5) Vertical Distribution of the UBC Forces	3.06		1.48	
	6) UBC Static Force Determination Procedures	3.01		1.43	
D. Seismic Analysis Procedures	1) Methods Used to Calculate Rigidities of Structural Elements, Including the Effects of Fixed, Pinned, or Semi-Rigid Member End Conditions	3.05		1.45	
	2) Distribution of Seismic Forces Based on Rigidity	3.06		1.46	
	3) Diaphragm Chord Forces, Drag Forces, and Diaphragm Shear	3.06		1.49	
	4) Methods to Distribute Shear Forces to Structural Elements	3.05		1.48	
E. Seismic Design	1) Seismic Detailing and Inherent Seismic Performance Characteristics for Steel	3.11		1.46	
	2) Seismic Detailing and Inherent Seismic Performance Characteristics for Concrete	3.19		1.45	
	3) Requirements for Horizontal and Vertical Seismic Forces	3.22		1.43	
	4) Requirements for Ties and Continuity, Collectors or Drags	3.02		1.46	
	5) Requirements for Anchorage of Concrete and Masonry Walls	3.21		1.46	
	6) Construction Materials	3.39			
	7) Construction Requirements for the Placement of Materials for the Lateral Load Resisting Elements	3.24			
	8) Testing, Special Inspection, and Structural Observation Requirements	3.19			

*Importance scores of 3 or higher used as cutoff; not comparable to other tables.

** Standard deviation data not provided for task items.

Table 9.3. Items Rated Critical on the Geotechnical Engineering Occupation Analysis

Tasks		Criticality Score (0-5)	Score, Most Critical (4 or higher)	S.D., Most Variable NA*	S.D., Least Variable NA*
A. Reconnaissance and Project Planning	1) Identify Potential Geotechnical Issues That May Influence Design of the Proposed Project	4.38	4.38		
	2) Determine Scope of Project Based on Client's Site Development Plans and Special Regulatory Requirements	4.11	4.11		
	3) Formulate Proposal or Work Plan for Field Exploration, Laboratory Testing, Analyses, or Preparation of Geotechnical Recommendations for the Proposed Project	4.02	4.02		
	4) Gather Relevant Data about Subsurface conditions at the Site by Reviewing Available Site Information	3.85			
	5) Identify Project Parameters Based on Discussion with Design Team and Consideration of Proposed Type of Structure, Structure Size, Site Used, Loading Conditions, and Site Grading	3.94			
B. Field Exploration	1) Determine Adequacy of Field Exploration Program for Proposed Project by Assessing Results of Field Exploration Program	3.92			
	2) Perform Subsurface Exploration and Sampling to Evaluate Subsurface Strata and Groundwater Conditions	4.02	4.02		
	3) Prepare Logs of Explorations to Include Field Descriptions of Soils, Details of Exploration and Sampling Operations, and Groundwater Conditions	3.57			
C. Laboratory Testing	1) Determine Shear Strength Parameters from Results of Laboratory Strength Testing	3.95			
	2) Determine Engineering Properties of Soil by Evaluating Results of Soil Classification Tests	3.69			
	3) Determine Soil Compressibility Parameters from Results of Laboratory Consolidation Testing	3.87			
	4) Classify Soil from Results of Laboratory Testing	3.58			
	5) Determine Expansion Characteristics of Soil From Results of Laboratory Expansion Testing	3.69			
D. Analyses and Development of Conclusions and Recommendations	1) Formulate Recommendations Regarding Slope Stability Based on Project Requirements, Analyses Performed, and Field and Laboratory Data	4.28	4.28		
	2) Formulate Recommendations for Shallow Foundation Design Based on Project Requirements, Analyses Performed, and Field and Laboratory Data	4.05	4.05		
	3) Formulate Recommendations for Site Grading Based on Project Requirements, Analyses Performed, and Field and Laboratory Data	3.87			
	4) Formulate Recommendations Regarding Site Settlement or Collapse Potential Based on Project Requirements, Analyses Performed, and Field and Laboratory Data	4.13	4.13		
	5) Formulate Recommendations for Earth Retention Systems Based on Project Requirements, Analyses Performed, and Field and Laboratory Data	3.90			
	6) Formulate Recommendations for Deep Foundation Design Based on Project Requirements, Analyses Performed, and Field and Laboratory Data	4.00	4.00		
	7) Formulate Recommendations Regarding Soil Expansion or Swell Potential Based on Project Requirements, Analyses Performed, and Field and Laboratory Data	3.78			
	8) Determine Risk and Safety Factors in Preparation of Design Recommendations	3.64			
	9) Formulate Recommendations for Liquefaction Based on Project Requirements, Analyses Performed, and Field and Laboratory Data	3.72			

* Standard deviation data not provided

Table 9.3. (continued) Items Rated Critical on the Geotechnical Engineering Occupation Analysis

Tasks		Criticality Score (0-5)	Score, Most Critical (4 or higher)	S.D., Most Variable NA*	S.D., Least Variable NA*
D. Analyses and Development of Conclusions and Recommendations	10) Formulate Recommendations for Subdrain Systems Based on Project Requirements, Analyses Performed, and Field and Laboratory Tests	3.54			
	11) Formulate Recommendations Regarding Temporary Excavations and Shoring Based on Project Requirements, Analyses Performed, and Field and Laboratory Data	3.54			
	12) Formulate Recommendations Regarding Ground Improvement or Ground Modification Based on Project Requirements, Analyses Performed, and Field and Laboratory Data	3.58			
	13) Develop Remedial Recommendations based on Analysis of Post-Construction Distress	3.57			
E. Report Preparation/Documentation	1) Document Recommendations Based on Geotechnical Findings and Conclusions in a Formal Written Report	4.47	4.47		
	2) Document Conclusions Based on Geotechnical Findings in a Formal Written Report	4.37	4.37		
	3) Describe Project Scope and Purpose of Work in a Formal Written Report	3.86			
	4) Describe Results of Document Review, Reconnaissance, Field Exploration, Laboratory Testing, and Analyses in a Formal Written Report	3.98			
	5) Describe Site Plan, Logs of Filed Exploration, Soil Profiles/Cross-Sections, and Laboratory Test Data in a Formal Written Report	3.75			
	6) Document Limitations of the Findings of the Geotechnical Investigation in a Formal Written Report	3.67			
	7) Describe Guideline Specifications for Geotechnical Aspects of the Proposed Project Based on Geotechnical Findings in a Formal Written Report	3.54			
F. Document Review, Construction Monitoring, and Post-Construction Observation	1) Assess Compliance with Geotechnical Recommendations by Reviewing Plans and Specifications	4.06	4.06		
	2) Assess Compliance with Geotechnical Aspects of Specifications by Observing and Testing Construction Activities	3.92			

Knowledges		Criticality Score (0-5)	Score, Most Critical (4 or higher)	S.D., Most Variable NA*	S.D., Least Variable NA*
A. Reconnaissance and Project Planning	1) Current “Standard of Care” for Geotechnical Investigations	4.04	4.04		
	2) Methodologies to Gather information Relevant to Site and Project Plan	4.00	4.00		
	3) Methodologies to Develop a Scope of Work for Geotechnical Investigation	4.00	4.00		
	4) Geotechnical Engineering Principles that Affect Geotechnical Planning	4.00	4.00		
	5) Techniques to Review and Interpret Existing Data for the Site	4.00	4.00		
	6) Geotechnical Requirements for Different Types of Construction	3.99			
	7) Effects of Local Geologic Hazards on Project Planning	3.93			
	8) Exploration Methodologies that Affect Project Work Plan	3.62			
B. Field Exploration	1) Field Exploration Methods to Evaluate Subsurface Conditions	4.15	4.15		
	2) Conditions that Affect Geotechnical Field Sampling Techniques	3.97			
	3) Field Methods to Document Site Conditions and Log Subsurface Conditions	3.92			
	4) Methodologies to Evaluate Soil Behavior in Field Investigations	3.83			

* Standard deviation data not provided

Table 9.3. (continued) Items Rated Critical on the Geotechnical Engineering Occupation Analysis

Knowledges		Criticality Score (0-5)	Score, Most Critical (4 or higher)	S.D., Most Variable NA*	S.D., Least Variable NA*
B. Field Exploration	5) Purposes for Different Field Sampling Techniques	3.81			
	6) Factors That May Alter the Work Plan During Field Investigation	3.80			
	7) Factors That Influence the Validity of In Situ Test Results	3.76			
	8) Different Types of Field Sampling Techniques	3.73			
C. Laboratory Testing Program	1) Procedures to Obtain Shear Strength Parameters from the Results of Laboratory Testing	3.92			
	2) Laboratory Tests to Classify Soil	3.89			
	3) Laboratory Tests that may Alter Work Plan	3.58			
D. Analysis and Development of Conclusions and Recommendations	1) Impact of Geotechnical Recommendations on Proposed Construction	4.43	4.43		
	2) Techniques to Characterize the Engineering Properties of the Subsurface Strata by Integration of Field and Laboratory Data	4.20	4.20		
	3) Impact of Results from the Static Slope Stability Analyses on Proposed Site Uses	4.11	4.11		
	4) Impact of Results from the Consolidation Settlement Analysis on Proposed Site Uses	4.03	4.03		
	5) Procedures to Determine if Field and Laboratory Data are Within Geotechnical Limits	3.99			
	6) Process for Evaluating Feasibility of Alternate Solutions in Geotechnical Investigations	3.99			
	7) Impact of Results from the Liquefaction Analysis on Proposed Site Uses	3.90			
	8) Impact of Results from the Distortion/Deformation Settlement Analysis on Proposed Site Uses	3.85			
	9) Impact of Results form the Analyses of Bearing capacity of Shallow Foundations on Proposed Site Uses	3.77			
	10) Impact of Results from the Soil Expansion Analysis on Proposed Site Uses	3.76			
	11) Impact of Results from the Analyses to Evaluate Suitability of fill Materials on Proposed Site Uses	3.71			
	12) Impact of Results from the Analyses of Axial Capacity of Deep Foundations on Proposed Site Uses	3.62			
	13) Impact of Results from the Static Lateral Earth Pressures Analysis on Proposed Site Uses	3.62			
	14) Effects of Regulatory Requirements on Formulation of Recommendations and Specifications	3.57			
	15) Procedures to Determine Risk and Safety Factors for Incorporation into Design Recommendations	3.55			
	16) Methods to Evaluate Post-Construction Distress	3.53			
	17) Methods to Evaluate Geologic Hazards On Site Based On Field and Laboratory Data	3.53			
E. Report Preparation/Documentation	1) Major Components of Geotechnical Investigation Reports	4.14	4.14		
	2) Limitations of the Geotechnical Investigation	4.06	4.06		
	3) Major Elements of File and Laboratory Documentation	3.79			
F. Document Review, Construction Monitoring, and Post-construction Monitoring	1) Factors to Consider When Reviewing Plans and Specification for Geotechnical Issues	4.17	4.17		
	2) Techniques to Remedy Unanticipated Geotechnical Conditions Encountered During Construction	4.08	4.08		
	3) Methods to Verify that Project Construction Conforms to Geotechnical Plans and Specifications	3.98			
	4) Methods to Interpret Observations and instrumentation Data During Construction	3.64			
	5) Required Components to Document Construction and Post-Construction Observations and Monitoring	3.56			

* Standard deviation data not provided.

Table 9.4. Items Rated Important on the Structural Engineering Occupation Analysis

Tasks		Importance Score (0-5)	Score, Most Important (4 or higher)	S.D., Most Variable	S.D., Least Variable
A. Determination of Design Criteria Based on Site Conditions	1) Analyze Site Specific Design Criteria and Design Codes to Identify Loads on the Structure	3.87			
	2) Determine Foundation and Structural Design Requirements Based on Information in Geotechnical Reports	3.95			
B. Selection of Structural Systems	1) Determine Project Specific Criteria by Using Applicable Codes	3.94			
	2) Select Economically Feasible Structural System	3.52			
	3) Select the Structural System to Meet Wind and Seismic Performance Requirements	4.33	4.33		
C. Determination of Forces and Analysis of Structures	1) Determine Dead and Live Loads for Structural Systems from Plans	4.21	4.21		
	2) Determine Forces Due to Wind	3.89			
	3) Determine Forces Due to Earth and Hydrostatic Pressures	3.71			
	4) Determine Governing Load Combinations for Design of Structure	4.22	4.22		
	5) Analyze Lateral Force Resisting System to Determine Deflections and Member Forces	4.23	4.23		
	6) Perform Seismic Analysis using Static Procedures	4.31	4.31		.96
	7) Determine Forces, Stresses, and Deflections of Horizontal Diaphragms	3.65			
	8) Verify Accuracy of Computer-Generated Output by Hand Calculations	3.72			
D. Design of Structural Elements	1) Design Structural Elements and Connections Using Steel	3.94			
	2) Design Structural Elements and Connections Using Concrete	3.96			
	3) Design Structural Elements and Connections using Wood	3.67		1.47	
	4) Design Structural Elements and Connections using Masonry	3.53		1.42	
	5) Design Structural Elements and Connections to meet Special Seismic Requirements	4.09	4.09		
	6) Design Horizontal Diaphragm Members and Their Connection Details	3.86			
	7) Design Connections Between Structural Elements and Foundation	4.09	4.09		
	8) Design Foundation Systems	4.00	4.00		
E. Construction Documents	1) Provide Member Sizes, Dimensions and Details to Prepare Structural Drawings for Construction	4.15	4.15		
	2) Prepare Seismic Force Resisting System Details for Structural Drawings	4.27	4.27		
	3) Prepare Specifications, and Testing and Inspection Requirements for Structural Systems to Satisfy Design Criteria	3.59		1.41	
F. Construction Administration	1) Review Shop Drawings and Submittals for Complex Details or Changes to Ensure Compliance with Design Criteria	3.69			
	2) Resolve Structural Issues that Occur During Construction	4.16	4.16		
G. Investigation, Evaluation, Retrofitting, and Renovation	1) Prepare Construction Documents for Structural Upgrades/Retrofit to Improve Performance of the Structure	3.50		1.45	

Table 9.4. (continued) Items Rated Important on the Structural Engineering Occupation Analysis

Knowledges		Importance Score (0-5)	Score, Most Important (4 or higher)	S.D., Most Variable	S.D., Least Variable
A. Determination of Design Based on Site Conditions	1) Effect of Wind and Seismic Factors on Design of Structural Systems	4.53	4.53		.86
	2) Effect of Jurisdiction on Applicable Building Codes and Design Requirements	3.55			
B. Selection of Structural Systems	1) Code Requirements Pertaining to the Configuration of a Structural System to Resist Effects of Horizontal Torsional Moments	3.51			
	2) Code Requirements Pertaining to Design of a Structural System to Resist Effects of Lateral Forces	4.46	4.46		.88
	3) Code Requirements Pertaining to Minimum Uniform and Concentrated Dead and Live Floor Loads to Consider in Floor Design	3.92			
	4) Code Requirements Pertaining to Minimum Uniform and Concentrated Dead and Live Roof Loads to Consider in Roof Design	3.86			
	5) Code Requirements Pertaining to Criteria for Allowable Deflection of Structural Members	3.72			
	6) Design and Performance of Reinforced Concrete Structures	3.91			
	7) Design and Performance of Structural Steel Structures	4.14	4.14		.99
	8) Design and Performance of Timber Structures	3.69		1.47	
	9) Structural Behavior Under Seismic Loads	4.50	4.50		.86
C. Structural Analysis Procedures	1) Code-Prescribed Static Lateral Force Analysis Procedures to Determine Design Base Shear	4.36	4.36		
	2) Effect of Wind Loads on Structural Design	4.05	4.05		
	3) Code-Prescribed Static Lateral Force Analysis Procedures to Determine Vertical Distribution of Seismic Forces	4.12	4.12		
	4) Code-Prescribed Static Lateral Force Analysis Procedures to Determine Limitations of Story Drift	3.78			
	5) Techniques to Interpret Computer-Generated Structural Analysis Output	3.69			
	6) Non-Computer Methods to Verify Accuracy of Computer-Generated Structural Analysis Output	3.66			
	7) Code Prescribed Procedures to Analyze Diaphragms	3.63			
D. Design of Structural Elements	1) Standards for Material Properties and Specifications	3.63			
	2) Code Requirements Pertaining to Working Stress Design to Accommodate Different Load Combinations	3.82			
	3) Code Requirements Pertaining to Load Factors and Load Combinations for Strength Design in Concrete Construction	4.01	4.01		
	4) Code Requirements Pertaining to Anchorage of a Structural System to Resist Uplift and Sliding Forces	3.99			
	5) Code Requirements Pertaining to Discontinuous Lateral Force Resisting Elements	3.55			
	6) Design Procedures for Steel Moment Frames	3.76			
	7) Design Procedures for Steel Moment Connections	3.86			
	8) Design Procedures for Steel Baseplates	3.54			
	9) Design Procedures for Steel Columns	3.80			
	10) Design Procedures for Steel Beam-Columns	3.73			
	11) Design Procedures for Steel Beams	3.93			
	12) Design Procedures for Steel Bracing	3.78			
	13) Design Procedures for Simple, Rigid, Welded, and Bolted Connections	3.93			
	14) Design Procedures for Concrete Foundations	3.96			
	15) Design Procedures for Concrete Flexural Members	3.82			

Table 9.4. (continued) Items Rated Important on the Structural Engineering Occupation Analysis

Knowledges		Importance Score (0-5)	Score, Most Important (4 or higher)	S.D., Most Variable	S.D., Least Variable
D. Design of Structural Elements	16) Design Procedures for Concrete Compression Members	3.75			
	17) Design Procedures for Concrete Flexural-Compression Members	3.68			
	18) Design Procedures for Concrete Shear Walls	3.77			
	19) Standards for Concrete Reinforcing Bar Details	3.76			
	20) Design Procedures for Plywood Diaphragms	3.63		1.47	
	21) Design Procedures for Wood Shear Walls	3.63		1.51	
	22) Design Procedures for Bolted, Nailed Connections in Wood Design	3.63		1.45	
E. Investigation, Evaluation, Retrofitting, and Renovation	1) Different Types of Strengthening Systems to Improve Structural Capacity	3.51			

Table 9.5. Items Rated Important on the Electrical Engineering Occupation Analysis

		Importance Score (0-4)	Score, Most Important (3 or higher)	S.D., Most Variable	S.D., Least Variable
A. Professionalism and Engineering Economics	1) Engineering Economics	2.87			
	2) Ethics	3.48	3.48		.79
	3) Professional Practice	2.92			
B. Management and Instrumentation	1) Analog to Digital/Digital to Analog Conversion	2.50			
	2) Grounding	3.24	3.24		.86
C. Electric Circuits	1) Ohm's Law	3.79	3.79		.52
	2) Coulomb's Law	3.12	3.12		
	3) Faraday's Law	3.13	3.13		
	4) Kirchhoff's Laws, Current Law/Nodal Analysis	3.43	3.43		.84
	5) Kirchhoff's Laws, Voltage Law/Mesh Analysis	3.40	3.40		.85
	6) Thevenin's Theorem	3.12	3.12		
	7) Norton's Theorem	3.01	3.01		
	8) Superposition	2.93			
	9) Source Transformation	2.69		1.09	
	10) Dependent Sources	2.54		1.11	
	11) Sinusoidal Steady State Analysis, Phasor Transforms	2.95			
	12) Sinusoidal Steady State Analysis, Diagrams	2.98			
	13) Sinusoidal Steady State Analysis, Operators	2.79			
	14) Sinusoidal Steady State Analysis, Power and Energy Calculations	3.42	3.42		.85
	15) Transient Analysis	2.86			
	16) Fourier Analysis	2.54		1.10	
	17) Transfer Functions	2.54		1.11	
	18) Complex Impedence	3.02	3.02		
	19) Laplace Transforms	2.51		1.12	
	20) Mutual Inductance	2.76			
D. Electronics, Electronic Circuits and Components	1) Solid State Device Characteristics and Ratings	2.56			
E. Electrical and Electronic Materials	1) Conductivity/Resisitivity	3.10	3.10		.87
	2) Thermal Characteristics	2.82			
	3) Electric Shock and Burns	2.89			
	4) General Public Safety	3.29	3.29		
	5) Semiconductors	2.53			
F. Electric and Magnetic Field Theory and Applications	1) Electrostatic Effects	2.51			
G. Computer Systems and Engineering	1) Logic Functions	2.62		1.10	
H. Control Systems	1) Feedback System Stability	2.58		1.08	
	2) Frequency Response	2.59			
I. Rotating Machines and Electromagnetic Devices	1) AC and DC Machines	2.97			
	2) Transformers	3.18	3.18		
J. Communications and Signal Processing	1) Signal to Noise Ratio	2.54		1.10	
K. Transmission and Distribution	1) Voltage Regulation	3.08	3.08		
	2) Power Factor Correction	3.06	3.06		

Table 9.6: Items Rated Important on the Mechanical Engineering Occupation Analysis

			Importance Score (0-4)	Score, Most Important (3 or higher)	S.D. Most Variable	S.D. Least Variable
A. Machine Design and Materials Tasks	1)	Select Pressure Vessels	2.56			
	2)	Select Mechanisms (e.g., linkages, gears, cams, bearings, etc)	2.50			
	3)	Design or Analyze Structures and Frames	2.64		1.12	
B. Hydraulics and Fluids Tasks	1)	Select Fans	2.71			
	2)	Design or Analyze Pumps	2.60			
	3)	Select Pumps	3.05	3.05		
	4)	Design or Analyze Piping Systems	3.07	3.07		
	5)	Design or Analyze Duct Systems	2.75			
	6)	Design of Analyze Hydraulic Components	2.52			
	7)	Select Hydraulic Components	2.83			
	8)	Select Pneumatic Components	2.56			
	9)	Select Air Compressors or Air System Accessories	2.53			
C. Energy Conversion/ Power Systems Tasks	1)	Select Power System Components	2.54		1.10	
D. HVAC and Refrigeration	1)	Design or Analyze HVAC Systems	2.61		1.13	
	2)	Select HVAC Systems	2.70		1.10	
	3)	Select HVAC Components	2.65		1.10	
	4)	Select Refrigeration Components	2.53		1.11	
	5)	Calculate Heating and Cooling Loads	3.09	3.09		
	6)	Calculate Refrigeration Loads	2.82		1.11	
	7)	Estimate Energy Usage	2.91			
E. Fire Protection Tasks	1)	Perform Hydraulic Calculations	2.57		1.18	
F. Codes and Standards Tasks	1)	Interpret and Utilize Codes and Standards	3.33	3.33		
G. General Knowledges	1)	Relevant Engineering Terminology	3.35	3.35		.72
	2)	Materials Properties	2.92			.83
	3)	Fluid Mechanics	3.16	3.16		.75
	4)	Heat Transfer Principles	3.18	3.18		.75
	5)	Mass Transfer Principles	2.77			
	6)	Economic Analyses	2.79			
	7)	Project Management	2.70			
	8)	Ethics	3.32	3.32		
	9)	General Knowledge of Regulations and Laws	2.82			.88
	10)	Relevant Industry and Company Design Standards	2.95			.88
H. Machine Design and Materials Knowledges	1)	Strength of Materials	3.13	3.13		
	2)	Fatigue Theory	2.61			
	3)	Statics and Dynamics	3.13	3.13		
	4)	Welding	2.51			
	5)	Pressure Vessels	2.66			

Table 9.6: (continued) Items Rated Important on the Mechanical Engineering Occupation Analysis

			Importance Score (0-4)	Score, Most Important (3 or higher)	S.D. Most Variable	S.D. Least Variable
I. Hydraulics and Fluids Knowledges	1)	Compressible Flow	2.54			
	2)	Incompressible Flow	2.81			
	3)	Stress Analysis	2.81			
	4)	Hydraulic Pumps	2.58			
J. Energy Conversion/Power Systems Knowledges	1)	Thermodynamic Cycles	2.94			
	2)	Thermodynamic Properties	3.02	3.02		
	3)	Energy Balances	3.07	3.07		
	4)	Pumps/Compressors	2.78			
K. HVAC and Refrigeration Knowledges	1)	Psychrometrics	2.85		1.10	
	2)	Thermodynamics	3.14	3.14		
	3)	Cooling/Heating Cycles	2.77			
	4)	Water Distribution Systems	2.51			
L. Codes and Standards Knowledges	1)	ASTM	2.55			
	2)	NFPA	2.54			
	3)	ASME	2.69			

Table 9.7. Items Rated Important on the Agricultural Engineering Occupation Analysis

Tasks			Importance Score (0-4)	Score, Most Important (3 or higher)	S.D. Most Variable	S.D. Least Variable
A. Soil and Water	1)	Analyze Hydraulic Data	3.05	3.05	.95	
	2)	Design Irrigation Systems	2.75			
	3)	Design Drainage Systems	2.87			
	4)	Design Water Control Structures	3.06	3.06		
	5)	Design Erosion Control Structures	2.94			
	6)	Design and Inspect Earthen Structures	3.08	3.08		
	7)	Design Watershed Remediation and Restoration	2.58			
	8)	Design for Land Application of Solid and Liquid Waste	2.80			
	9)	Develop Best Management Practices for Soil and Water Conservation and Waste Management	2.95			
B. Power and Machinery	1)	Design Machinery Systems	3.04	3.04		
	2)	Design Power Hydraulic Systems	2.82			
	3)	Design and Utilize Electrical Power Systems	2.74			
	4)	Design and Select Power Transmission Systems	2.63			
	5)	Design and Select Traction and Tillage Systems	2.50			
C. Processing and Handling of Biological Products	1)	Design Hydration and Conditioning Systems	2.59			
	2)	Design Physical Separations	2.55			
	3)	Design and Select Materials Handling Systems	2.80			
D. Structures and Environment	1)	Design/Analyze Agricultural and Related Light Commercial Structures	2.95			
	2)	Design/Analyze Animal and Greenhouse Production and Product Storage Systems	2.81			
	3)	Design/Analyze Structural Systems	2.99			
	4)	Design/Analyze Ventilation Systems	2.89			
	5)	Design/Analyze Waste Storage and Treatment Facilities	3.07	3.07		
	6)	Assess Interaction of the Designed Facility with Plant/ Animal/Product Being Housed, Stored, or Processed	2.76			
	7)	Design/Analyze Storage, Handling, and Containment Systems for Hazardous Materials	2.74		1.03	
E. Biological Systems	1)	Analyze/Identify Properties of Plants/Animals to Optimize the Health/Quality/Sustainability of the Product	2.60		.99	
	2)	Design/Analyze Biological Processes	2.54			
	3)	Design/Analyze Agricultural Production Systems	2.60			
	4)	Assess Environmental Impact of Processes/Facilities	2.90			
	5)	Design/Restore/Preserve Ecological Systems	2.64		.96	
F. Core Tasks	1)	Characterize the Engineering Properties of Materials	2.86			
	2)	Characterize Fluid and Thermal Flow Through Porous Media	2.57			
	3)	Calculate Energy and Power Requirements	3.09	3.09		
	4)	Calculate and Interpret Mass Balances	2.93			
	5)	Calculate and Interpret Energy Balances	2.89			
	6)	Analyze Load-Carrying Elements	2.96			

Table 9.7. (continued) Items Rated Important on the Agricultural Engineering Occupation Analysis

Tasks			Importance Score (0-4)	Score, Most Important (3 or higher)	S.D. Most Variable	S.D. Least Variable
F. Core Tasks	7)	Analyze Air Vapor Mixtures	2.50		.95	
	8)	Analyze Fluid Flow Systems	2.82			
	9)	Conduct and/or Interpret Statistical Analyses	2.69			
	10)	Conduct and Interpret Construction and Topographic Surveys	2.69		.95	
	11)	Interpret Model Results	2.81			
	12)	Interpret Laboratory Test Results	2.95			
	13)	Interpret Graphical and Tabular Engineering Data and Information	3.13	3.13		
	14)	Design Processes and Procedures Based on Human Factors, Ergonomics, Health and Personal Protection	2.87			
	15)	Develop Clear, Logical, and Accurate Plans and Specifications	3.42	3.42		.73
	16)	Design Pumping Systems	2.58			
	17)	Design Control Systems	2.64			
	18)	Evaluate Products and Processes for Conformance and Specifications	2.86			
	19)	Diagnose and Recommend Solutions to Technical Problems	2.98			
	20)	Conduct Failure Analysis	2.70			
	21)	Evaluate Risks to Community Health, Safety, and Exposure	2.95			
	22)	Supervise Construction and Fabrication	2.75			
	23)	Understand and Interpret Risk Analyses	2.69			
	24)	Perform Economic Analyses	2.68			
	25)	Determine Ethical Conduct	3.19	3.19		
	26)	Review/Interpret/Apply Available Information	3.14	3.14		
	27)	Determine Requirements of Codes and Standards	3.05	3.05		
	28)	Prepare Procedures and Standard Practices	2.51			
	29)	Report Technical Information to Professional and Lay Audiences	2.98			

Knowledges			Importance Score	Score, Most Important	S.D. Most Variable	S.D. Least Variable
A. Soil and Water	1)	Hydrology	3.27	3.27		
	2)	Principles of Soil Physics	2.86			
	3)	Soil Mechanics	2.74			
	4)	Evapotranspiration	2.52			
	5)	Open Channel Hydraulics	3.14	3.14		
	6)	Hydrogeology	2.70			
	7)	Principles of Nutrient Management/Loading Rates in Soils	2.58			
	8)	Principles of Irrigation	2.89			
	9)	Principles of Surface and Subsurface Drainage	2.89			
	10)	Sediment Transport	2.76			
	11)	Erosion Control and Slope Stabilization	3.06	3.06		
B. Power and Machinery	1)	Agricultural Mechanization	2.85			
	2)	Machine/Commodity Interactions	2.69			
	3)	Machine/Soil Interactions	2.62			
	4)	Machine Component Design	2.92			
	5)	Understand Stress/Strain Relationships	3.19	3.19		
	6)	Materials Selection	2.99			

Table 9.7. (continued) Items Rated Important on the Agricultural Engineering Occupation Analysis

Knowledges			Importance Score	Score, Most Important	S.D. Most Variable	S.D. Least Variable
B. Power and Machinery	7)	Fatigue Analysis	2.76			
	8)	Stability Analysis	2.97			
	9)	Internal Combustion Engines	2.58			
	10)	Electrical Circuit Analysis	2.79			
	11)	Hydraulic Power Circuits	2.86			
	12)	Power Requirement Analysis	2.92			
	13)	Mechanical Power Transmission	2.88			
C. Processing and Handling of Biological Products	1)	Fundamental Physical Chemistry	2.72			
	2)	Mass Transfer Between Phases	2.51			
	3)	Bulk Solids Characterization	2.63			
	4)	Principles of Unit Operations	2.60			
	5)	Compatibility of Biological Materials	2.59			
	6)	Standards, Codes, and Regulations	2.87			
D. Structures and Environment	1)	Structural Loads and Standards	3.38	3.38		.77
	2)	Structural Analysis	3.21	3.21		
	3)	Provisions of Structural Materials Design Specification/Codes	3.02	3.02		
	4)	Standards for Post-Frame Building Design	2.68			
	5)	Steady State Heat and Mass Balances	2.58			
	6)	Ventilation Rate Requirements	2.83			
	7)	Ventilation System Requirements	2.85			
	8)	Insulation Requirements	2.72			
	9)	Moisture Control Standards for Building Construction	2.61			
D. Structures and Environment	10)	Air Quality Standards/Requirements in Agricultural Buildings/Confined Spaces for Humans, Animals, Plants and Produce	2.89			
	11)	Functional and Space Requirements for Agricultural Production Facilities	2.55			
	12)	Electrical Wiring/Lighting Devices	2.71			
	13)	Requirements for Hazardous Materials Storage Facilities	2.83		.96	
	14)	Construction Materials	2.91			
E. Biological Systems	1)	Ergonomics	2.52			
	2)	Environmental Assessment Techniques	2.66			
	3)	Awareness of Ecological Processes	2.66			
F. Core Knowledge	1)	Applied Mathematics	3.23	3.23		
	2)	Statistics	2.93			
	3)	Statics and Dynamics	3.25	3.25		.77
	4)	Fluid Mechanics	3.32	3.32		.69
	5)	Thermodynamics	2.97			
	6)	Psychrometric Processes	2.71			
	7)	Heat Transfer	2.80			
	8)	Strength of Materials and Structural Mechanics	3.26	3.26		.73
	9)	General Mass and Energy Balances	2.79			
	10)	Water Relationships	2.73			
	11)	Pump Principles	2.74			
	12)	Fan Principles	2.57			
	13)	Sensors, Instrumentation, and Control Circuits	2.68			
	14)	Engineering Economics Analysis	2.86			

Table 9.7. (continued) Items Rated Important on the Agricultural Engineering Occupation Analysis

Knowledges			Importance Score	Score, Most Important	S.D. Most Variable	S.D. Least Variable
F. Core Knowledge	15)	Knowledge of Ethics	3.32	3.32		
	16)	The Role of Codes, Regulations, and Standards in Professional Practice	3.17	3.17		
	17)	Applicable Codes, Regulations, and Standards in Specific Areas of Practice	3.10	3.10		
	18)	Procedure and Specification Documentation	2.90			

Table 9.8. Items Rated Important on the Chemical Engineering Occupation Analysis

			Importance Score (0-4)	Score, Most Important (3 or Higher)	S. D. Most Variable NA*	S.D. Least Variable NA*
A. Ethics	1)	Canon of Ethics of Professional or Technical Society	2.5			
B. Engineering Economics	1)	Engineering Economics	2.8			
C. Communication	1)	Oral Communications	3.5	3.5		
	2)	Written Communications	3.5	3.5		
	3)	Drawing and Graphics	2.6			
D. Physical and Engineering Sciences	1)	Chemistry	3.0	3.0		
	2)	Thermal Science	2.6			
	3)	Fluid Mechanics	2.8			
E. Computer Science	1)	Software	2.7			
F. Material Science	1)	Chemical Properties	2.7			
G. Other						
	1)	Measurement and Instrumentation	2.7			
	2)	Codes and Standards	2.7			
	3)	Mass and Energy Balances	3.2	3.2		
	4)	Applied Thermodynamics	2.8			
	5)	Applied Fluid Mechanics	2.8			
	6)	Heat Transfer	2.9			
	7)	Mass Transfer	2.7			
	8)	Chemical Process Control	2.9			
	9)	Chemical Process Design	2.9			
	10)	Chemical Equipment Design	2.7			

*Standard deviation data not provided.

Table 9.9. Items Rated Important on the Control Systems Engineering Occupation Analysis

Professional Activities		Importance Score (0-5)	Score, Most Important (4 or higher)	S.D., Most Variable	S.D., Least Variable
				NA*	NA*
A. Conceptual Design/Definition of Control Systems	1) Study Potential Control System Application to Define Control System Objectives and Functions	4.32	4.32		
	2) Prepare Specifications of Control System Performance Needed to meet Application Objectives	4.16	4.16		
	3) Specify Kinds and Locations of Sensors and Switches Needed as Inputs for Control System Functions	3.89			
	4) Specify Kinds and Locations of Control Actions or Outputs Needed to Achieve System Objectives	4.02	4.02		
B. Control Strategies	1) Develop Control Strategies to Achieve Application Objectives	4.16	4.16		
	2) Apply Basic Control Techniques	4.09	4.09		
	3) Apply Advanced Control Techniques	3.76			
	4) Evaluate Performance of Existing Control Systems	3.66			
	5) Troubleshoot Existing Control Systems to Correct Malfunctions or Poor Performance and Achieve System Objectives	3.84			
C. Logical/Sequential Control Systems	1) Specify Functions for Logical/Sequential Control Systems	3.61			
D. Digital Computer Applications	1) Design (or Configure) Distributed Control Systems	3.55			
E. Control Valves, Actuators and Final Elements	1) Select Final Elements to Implement Control Strategies	3.83			
	2) Calculate Control Valve Size	3.53			
	3) Select Control Valve Type and Characteristics	3.61			
F. Safety and Relief Valves	1) Analyze Processes to Define Risks and Most Likely Failures	3.59			
	2) Analyze Processes to Determine Type of Safety System Needed	3.58			
	3) Ensure Compliance with Applicable Government, Industry, Owner, and Good-Practice Safety Standards or Laws	3.85			
	4) Check Safety System Design to Ensure Protection Against All Significant Hazards	3.81			
	5) Determine Where Safety and Relief Valves are Needed	3.54			
	6) Define Process Conditions which will Initiate Alarms or Shutdowns	3.65			
G. Alarm/Shutdown Switches	1) Ensure Compliance of Switch Selection and Settings with Applicable Codes	3.55			
H. Flow Measurement	1) Select Proper Flowmeter For Application	3.86			
	2) Determine Process Characteristics and Flow Measurement Range from Process Flow Diagrams	3.69			
I. Other Measurements	1) Select Appropriate Devices to Measure Temperature, Level, Pressure, Speed, Position, etc., as Needed to Satisfy System Requirements	3.87			
J. Data Transmission and Communication Networks	1) Select Appropriate Media for Transmission of Plant Data for Control and Information Functions	3.84			
	2) Select Proper Ranges for Transmitters from Process Data	3.71			
	3) Select Transmitters to Suit Hazardous Areas	3.69			
K. Operator Interface, Panels, and Displays	1) Design Emergency Shutdown Systems	3.84			
L. Project Management	1) Review System Design for Compliance with Functional Requirements and Applicable Codes	3.90			
	2) Write Control System Specifications and Requests for Proposals or Quotations	3.75			
	3) Evaluate Proposals, Quotations or Bids	3.75			
	4) Select Vendors	3.53			
	5) Review Vendor Drawings for Completeness and Compliance with Specifications	3.53			

*Standard deviation data not provided

Table 9.9. (continued) Items Rated Important on the Control Systems Engineering Occupation Analysis

Professional Activities		Importance Score (0-5)	Score, Most Important (4 or higher)	S.D., Most Variable NA*	S.D., Least Variable NA*
L. Project Management	6) Train Junior Engineers in Accomplishing Tasks Performed by Control Systems Engineers	3.64			
	7) Coordinate with Other Engineering Disciplines and Various Crafts During Construction, Installation, Checkout, Commissioning and Startup	4.02	4.02		
	8) Plan and Supervise System Checkout and Commissioning	3.55			
	9) Test the Completed System as a Unit at the Installation Site	3.79			
	10) Make Field Changes to Correct Errors and Omissions	3.74			
	11) Adjust Control System Parameters Based on Performance in the Plant	3.76			
	12) Modify the Configuration or Programming of Digital Devices as Required During Startup	3.60			
M. Documentation	1) Read and Understand Process Flow Diagrams	4.31	4.31		
	2) Prepare, Read and Understand Piping and Instrument Drawings	4.30	4.30		
	3) Prepare, Read and Understand Instrument Loop Diagrams Using Various Symbols	4.25	4.25		
	4) Prepare, Read and Understand Flow Charts for Computer Programs	3.51			
	5) Prepare, Read and Understand Ladder-Type Diagrams for Relay and Logic Schematics	3.85			
	6) Read and Understand Electrical One-Line Diagrams	3.51			
	7) Update Drawings and Other Documentation to Reflect Changes to the System and Ensure the Availability of Correct Information on the Current System Structure and Parameters	3.61			
N. Applications	1) Design and Implement Control Systems for Continuous Processes	4.02	4.02		
	2) Design and Implement Control Systems for Batch Processes	3.94			
	3) Design and Implement Control Systems for Energy Conservation and Transmission Systems	3.87			
	4) Design and Implement Control Systems for Strip, Sheet and Fiber Processes	3.68			
	5) Design and Implement Control Systems for Distributed Processes	3.69			

Professional Requirements		Importance Score (0-5)	Score, Most Important (4 or higher)	S.D., Most Variable NA*	S.D., Least Variable NA*
A. Ethics	1) Canon of Ethics of Professional or Technical Society	3.83			
	2) Rules of Professional conduct of State Registration Board	3.90			
B. Communication	1) Oral Communication	3.62			
	2) Written Communication	3.79			
	3) Drawings and Graphics	3.63			
C. Codes and Standards	1) Codes and Standards	3.58			
D. Fundamentals of Measurement	1) Fundamentals of Measurement	3.85			
E. Knowledges	1) Sensor Selection	3.64			
	2) Valves and Final Elements	3.57			
	3) Controllers/Modes/Tuning	3.77			
	4) Digital Control Systems	3.66			
	5) Discrete Logic and Sequencing	3.60			
	6) Alarms	3.53			
	7) Interlocks	3.66			
	8) Control System Analysis	3.77			
	9) Process Dynamics	3.65			

*Standard deviation data not provided.

Table 9.10. Items Rated Important on the Industrial Engineering Occupation Analysis

			Importance Score (0-4)	Score, Most Important (3 or Higher)	S. D. Most Variable NA*	S.D. Least Variable NA*
A. Ethics	1)	Canon of Ethics of Professional or Technical Society	2.7			
	2)	Rules of Professional Conduct of State Registration Board	2.6			
B. Engineering Economics	1)	Engineering Economics	3.1	3.1		
C. Communication	1)	Oral Communications	3.5	3.5		
	2)	Written Communications	3.6	3.6		
	3)	Drawing and Graphics	2.8			
D. Mathematics and Statistics	1)	Probability and Statistics	2.7			
E. Computer Science	1)	Software	2.7			
F. Other						
	1)	Management Principles	3.1	3.1		
	2)	Work Methods and Management Techniques	2.7			
	3)	Manufacturing Processes	2.7			
	4)	Systems Design/Analysis	2.7			
	5)	Statistical Quality Control	2.6			
	6)	Cost Analysis	3.1	3.1		
	7)	Optimization Methods	2.5			

*Standard deviation data not provided.

Table 9.11. Items Rated Important on the Manufacturing Engineering Occupation Analysis

		Importance Score (0-4)	Score, Most Important (3 or higher)	S.D., Most Variable	S.D., Least Variable
A. Product/Process Design, Materials Application	1) Metals	3.01	3.01		.73
	2) R&D, Prototyping, Testing	2.61			
	3) Design/Concurrent Engineering	2.86			
	4) Design for X (Mfg/Assm/Maint/etc)	2.87			
	5) Engineering Graphics	2.73			
	6) Engineering Design Analysis	2.76			
	7) Cost Engineering/Analysis	2.92			.76
	8) Tolerance Analysis/GD&T	2.66			
	9) Process Design, Development, and Producibility	3.08	3.08		.72
B. Manufacturing Process Applications and Operation	1) Material Removal Processes	2.69			
	2) Fabrication Processes	2.74			.75
	3) Joining and Assembly Processes	2.77			.78
C. Production System and Equipment Design	1) Tool and Equipment Selection	2.79			
	2) Machine Design	2.56		1.05	
	3) Production System Design	2.69			
	4) Process Planning	2.77			.77
	5) Capacity Planning	2.51			
	6) Cost Justification	2.98			.74
	7) Safety, Health, and OSHA	2.80			
D. Automated Systems and Control	1) CAD/CAM/CIM Systems	2.71			
E. Quality	1) Probability and Statistics	2.51		.99	
	2) Statistical Control Methods	2.56			
	3) Process and Equipment Capability Analysis	2.60			
F. Manufacturing Management	1) Project Management	2.97			
	2) Business/Engineering Ethics	2.84		1.01	

Table 9.12. Items Rated Important on the Metallurgical Engineering Occupation Analysis

		Importance Score (0-4)	Score, Most Important (3 or higher)	S.D., Most Variable	S.D., Least Variable
A. General	1) Mathematics; Arithmetic Calculations	3.35	3.35		.84
	2) Mathematics; Algebraic Calculations	3.13	3.13		
	3) Statistics; Data Analysis	2.65			
	4) Physical/Engineering Sciences; Phase Equilibria	2.55			
B. Extractive Metallurgy Fundamentals	1) Mass Balance	2.50		1.29	
	2) Thermodynamics	2.51		1.24	
C. Extractive Metallurgy Processes	1) Material Balances	2.54		1.26	
D. Physical Metallurgy Fundamentals-Structure of Metals	1) Crystalline Properties of Metals; Elastic Deformation	2.69			
	2) Crystalline Properties of Metals; Plastic Deformation	2.83			
	3) Crystalline Properties of Metals; Strengthening Mechanisms	2.88			
	4) Annealing of Metals; Recovery-Recrystallization	2.71			
	5) Annealing of Metals; Grain Growth	2.70			
	6) Metallography; Microstructure/Macrostructure	3.17	3.17		
	7) Physical Chemistry; Phase Diagrams	2.81			
	8) Physical Chemistry; Phase Diagrams; Solidification	2.60			
	9) Physical Chemistry; Phase Diagrams; Transformations	2.73			
	10) Physical Chemistry; Solid Solutions	2.55			
	11) Electrochemistry of Metals; Corrosion Mechanisms	2.89			
E. Mechanical Metallurgy	1) Mechanical Fundamentals; States of Stress	2.68			
	2) Yielding of Metals	2.87			
	3) Theories of Fracture; Fracture Mechanisms	2.99			
	4) Theories of Fracture; Fracture Mechanisms; Fracture Mechanics	2.71			
	5) Theories of Fracture; Fatigue	2.90			
F. Fabrication and Mechanical Processing	1) Joining	2.55			
	2) Joining; Welding	2.71			.90
G. Materials Processing Procedures	1) Thermal Treatment of Alloys; Ferrous Alloys; Hardenability	2.96			
	2) Thermal Treatment of Alloys; Ferrous Alloys; Austenitizing	2.82			
	3) Thermal Treatment of Alloys; Ferrous Alloys; Hardening	2.95			.87
	4) Thermal Treatment of Alloys; Ferrous Alloys; Tempering Embrittlement	2.50			
	5) Thermal Treatment of Alloys; Non-Ferrous Alloys; Annealing	2.71			
	6) Thermal Treatment of Alloys; Non-Ferrous Alloys; Age Hardening	2.77			
	7) Surface Modification	2.52			
H. Alloy Selection	1) Ferrous; Material Properties; Mechanical	2.96			
	2) Ferrous; Specifications; Chemical	2.65			
	3) Non-Ferrous; Material Properties; Mechanical	2.75			
I. Material Testing	1) Mechanical Testing; Tensile	3.14	3.14		
	2) Mechanical Testing; Hardness	3.02	3.02		
	3) Mechanical Testing; Fatigue	2.83			
	4) Mechanical Testing; Fracture Toughness	2.71			

Table 9.13. Items Rated Important on the Petroleum Engineering Occupation Analysis

Tasks		Importance Score (0-4)	Score, Most Important (3 or higher)	S.D., Most Variable	S.D., Least Variable
A. Drilling	1) Understand and Use Well or Project Objectives to Design Well	3.06	3.06		
	2) Prepare Drilling Cost Estimates	2.72		1.13	
	3) Design Wells and Develop Drilling Plans	2.84		1.12	
	4) Provide Surveillance on Wells Being Drilled and Optimize Drilling Performance	2.61		1.09	
	5) Evaluate Completed Wells for Improvements in Drilling	2.74		1.13	
B. Completion, Production and Facilities	1) Determine the Optimum Production Profile for a Given Well/Field	3.07	3.07		
	2) Design the Various Elements of, and Prepare Cost Estimates for Well Completion, Recompletion, and Remedial Work	3.02	3.02	1.07	
	3) Design Cost Estimates for Subsurface Production String and Assembly	2.60		1.09	
	4) Manage the Execution of Well Completion, Recompletion or Remedial Work	2.56		1.06	
C. Reservoir	1) Prepare Reservoir Description	2.80			
	2) Analyze Reservoir Fluids Behavior	2.67			
	3) Estimate Reserves/Contingent Resources	3.34	3.34		
	4) Analyze and Monitor Reservoir Performance	3.34	3.34		
	5) Predict Future Reservoir Performance	3.19	3.19		
	6) Design and Implement Field Development Projects	2.86			
	7) Manage the Reservoir for Optimal Value	3.28	3.28		
D. Formation Evaluation	1) Determine the Formation Evaluation Data Required for Well/Project	2.82			
	2) Interpret/Integrate Results of Formation Evaluation Data	2.99			

Knowledges		Importance Score (0-4)	Score, Most Important (3 or higher)	S.D., Most Variable	S.D., Least Variable
A. Common Knowledge	1) Principles of Mathematics and the Physical Sciences	2.95			
	2) Petroleum Engineering Terminology	3.54	3.54		.66
	3) Relevant Industry and Company Design Standards	3.02	3.02		
	4) Relevant Industry Regulatory/Environmental Law	2.70			
	5) Industry and/or Company Provided Technical Software/Informational Databases	2.91			
	6) Project Management Techniques	2.81			
	7) Geoscience Principles	2.95			
	8) Risk Analysis/Contingency Planning	2.85			
	9) Surveillance/Optimization Techniques	2.85			
	10) Economic Principles	3.26	3.26		
	11) Multi-Disciplinary Team Participation	3.17	3.17		
	12) Professionalism Including Ethics and Due Diligence	3.41	3.41		.73
B. Drilling	1) Tubulars	2.92			
	2) Cementing	2.86			
	3) Drilling Fluids	2.86			
	4) Drill String	2.64			
	5) Drilling Mechanics	2.78			
	6) Hydraulics	2.84			
	7) Directional/Horizontal Drilling	2.68			
	8) Well Control/BOP	2.96		1.05	
	9) Bits	2.56			

Table 9.13. (continued) Items Rated Important on the Petroleum Engineering Occupation Analysis

Knowledges		Importance Score (0-4)	Score, Most Important (3 or higher)	S.D., Most Variable	S.D., Least Variable
C. Completion, Production and Facilities	1) Proper Lift Mechanism Selection Given a Set of Well Conditions	3.03	3.03		
	2) Sucker Rod Pumping Systems	2.56			
	3) Well and Completion Systems Including Nodal Analysis	3.09	3.09		
	4) Inflow Performance curve Analysis	3.11	3.11		
	5) Production Logging	2.65			
	6) 2D Sand Fracture Treatments	2.54			
	7) Matrix Acid Treatments	2.56			
	8) Tubing and Downhole Equipment	2.81			
	9) Remedial/Recompletion Operations	3.04	3.04		
	10) Selections of Piping to Accommodate Flow Rate, Total Pressure and Pressure Drop Considerations	2.83			
D. Reservoir	1) Reservoir Geoscience	2.81			
	2) Oil/Gas Reservoir Performance	3.38	3.38		.70
	3) Methods to Determine Net Pay	3.07	3.07		.76
	4) Phase Behavior/Reservoir Fluids	2.81			
	5) Single/Multiphase Flow in Porous Media	2.85			
	6) Methods for Estimating Reserves and Recoveries	3.54	3.54		.71
	7) Reservoir Development Techniques	3.13	3.13		.77
	8) Water/Gas Injection	2.71			
	9) Reservoir Simulation Techniques	2.62			
E. Formation Evaluation	1) Physical Measurements	2.61			
	2) Derivation of Properties from Formation Evaluation Data Including Lithology, Mechanical Rock Properties, fluid Properties and Borehole Dimensions	2.82			
	3) Lithology	2.73			
	4) Fluid Properties	2.81			.78
	5) Logging Methods	2.95			.78
	6) Well Testing	2.98			

Table 9.14. Items Rated Important on the Traffic Engineering Occupation Analysis

Tasks		Importance Score (0-5)*	Score, Most Important (3.5 or higher)	S.D., Most Variable NA**	S.D., Least Variable NA**
A. Circulation, Trip Generation, parking, and Land Use	1) Recommend Roadway Mitigations Based on Forecast of Transportation Demands to Improve Level of Service	3.20			
B. Level of Service and Capacity	1) Evaluate Traffic Volume Data to Determine Infrastructure Design	3.07			
	2) Evaluate Development Projects for On- and Off-Site Geometrics to Determine Operational Efficiency and Safety of Traffic Flow	3.05			
C. Transportation Facilities Design	1) Develop Intersection Channelization Plans to Facilitate Movements of Vehicles and Pedestrians	3.10			
	2) Develop Plans for Roadway Signing and Striping to Facilitate Movements of Traffic	3.28			
D. Traffic Controls	1) Identify Need for Traffic Control Device Modifications Based on Accident Rates, Traffic Volumes, and Changes in Traffic Patterns	3.16			
	2) Specify Signs, Markings, and Delineators to Regulate, Warn, and Guide Motorists	3.31			
E. Traffic Flow	1) Recommend Corrective Measures to Reduce Accident Potential/Occurrences	3.30			

Knowledges		Importance Score (0-5)*	Score, Most Important (3.5 or higher)	S.D., Most Variable NA**	S.D., Least Variable NA**
A. Circulation, Trip Generation, Parking and Land Use	1) Techniques for Calculating Level of Service of Roadways and Intersections	3.40			
	2) Warrants that Define Minimum Requirements for Installation of Traffic Controls	3.68	3.68		
	3) Relationship Between Roadway Classification or Intersection Geometrics and Carrying Capacity	3.29			
	4) Techniques for Mitigating Traffic Impacts	3.51	3.51		
	5) Roadway Features that Affect Capacity	3.39			
B. Transportation Facilities Design	1) Relationship Between Motorist Characteristics and Sight Distance Requirements	3.36			
	2) Methods for Applying Roadway Design Elements	3.33			
	3) Effect of Vehicle Turning Radii for Vehicle Classifications in Determining Roadway Characteristics	3.13			
	4) Channelization Standards for Intersections to Regulate Traffic Movement	3.29			
	5) Standards for the Identification and Placement of Signing and Striping Elements	3.70	3.70		
	6) Standards for Guiding Traffic through Construction and Maintenance Zones	3.24			
C. Traffic Signals and Lighting	1) Relationship Between Traffic Flow and the Development of Signal Timing Plans	3.00			
	2) Interaction Between Time, Space, and the Movement of Vehicles Through Intersections	3.03			
	3) Standards that Apply to the Selection of Signal Type and Placement	3.10			
	4) Procedures for Applying Warrants/Standards used to Justify the Implementation of Traffic Control Devices	3.73	3.73		
	5) Relationship Between Signal Phasing and the Control of Right-of-Way through Intersections	3.35			
D. Traffic Controls	1) Relationship Between Cycle Length, Splits, and Offsets	3.00			
	2) Standards for Determining Intersection Signal Timing Based on Traffic and Pedestrian Requirements	3.15			
	3) Effects of Phasing on Signal Timing	3.27			
	4) Relationship Between Signal Timing/Phasing and Accident Mitigation	3.06			
	5) Elements to be Evaluated When Performing Traffic Control Studies	3.02			

* Importance scores of 3 or higher used as cutoff; not comparable to other tables.

** Standard deviation data not provided.

Table 9.14. I(continued) tems Rated Important on the Traffic Engineering Occupation Analysis

Knowledges		Importance Score (0-5)*	Score, Most Important (3.5 or higher)	S.D., Most Variable NA**	S.D., Least Variable NA**
	6) Procedures for Conducting and Interpreting Traffic Engineering Studies	3.56	3.56		
	7) Measures that Remedy Safety and Operational Deficiencies	3.56	3.56		
	8) Laws, Regulations, and Guidelines Pertaining to Traffic	3.84	3.84		
E. Traffic Flow	1) Measures for Optimizing Traffic Flow	3.14			
	2) Types of Pavement Striping Based on Roadway Characteristics and Prevailing Conditions	3.09			
	3) Knowledge of Methods for Identifying Hazardous Traffic Locations/Conditions	3.14			
	4) Traffic Engineering Measures for Improving Roadway Safety	3.64	3.64		
	5) Methods for Evaluating the Effectiveness of Safety Improvement Measures	3.07			
	6) Relationship Between Roadway Characteristics and Accident Potential	3.32			

* Importance scores of 3 or higher used as cutoff; not comparable to other tables.

** Standard deviation data not provided.